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The Journal of the Mysore Farmers' Forum

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Editorial

CROP PROTECTION

In his inaugural speech at the Bangalore District Farmers' Seminar and Conference held recently, Shri M. V. Krishnappa, Union Deputy Minister for Agriculture, stressed upon an important aspect of Agricultural Production, namely Crop Protection—from insects, diseases, rats, monkeys and stray cattle. According to one reliable estimate he said, grains worth nearly Rs. 400 crores were annually destroyed by pests. Even if the country spent nearly Rs. 50 crores on Plant Protection, it was worth it, the Deputy Minister added.

With the advent of modern pesticides from 1940 onwards, a great impetus has been given to Agricultural Crop Protection in our country and to-day every State in India has a well-equipped Plant Protection Organisation. Apart from this, the Central Government has established Plant Protection Pools at various parts of the country to meet emergency requirements. One such Pool has been located at Dharwar in our State. Besides this, the State Department of Agriculture has also been purchasing and distributing Plant Protection Chemicals to a considerable extent, apart from rendering technical guidance and help to the cultivators.

One major aspect of Plant Protection is, however, generally overlooked, namely, the rendering of Plant Protection Measures widely over the fields and plots in any given area. Failure to treat, even a small patch, has often resulted in the subsequent 'build-up' of pests and diseases, later on migrating to formerly treated areas. This would nullify the very object of crop protection. Pests and diseases are no respecters of individuals. This factor should be borne clearly in mind by one and all. Community efforts in applying plant protection measures in time over all the affected areas is the only remedy in avoiding losses due to pests. It is hoped that our members both in the Farmers' Forum and Young Farmers' Association will take necessary steps in educating other cultivators in this regard.

We would also like to stress herein, the absolute necessity of a group of cultivators and/or Gram Panchayats equipping themselves with appliances like a couple of sprayers and dusters and leasing them out to needy cultivators for the payment of a small sum. Possession of essential equipments and Plant Protection Chemicals will go a long way in nipping early infestations of pests and diseases in the villages and thus curbing outbreaks at a subsequent date.

Research Articles

STUDIES ON POTASH MANURING OF PADDY AND RAGI IN MYSORE

By B. V. Venkata Rao and S. S. Sirur*

Introduction

Potassium is considered to be a major nutrient element in the manuring of crops as it is concerned in chlorophyll formation, photosynthesis and carbohydrate formation, cell division and such other numerous important functions in plant life. Its role in inducing disease resistance and offsetting the ill-effects of excessive quantities of nitrogen and phosphorus is also well recognised. But paradoxically enough, the crop responses to applications of potassic salts in manuring is rarely found to be remunerative except in some soils and specially potassium loving crops. Earlier work in Mysore (*Annual Reports of the Agricultural Chemist*, Mysore, 1935–39) and elsewhere in India (Sethi, Ramaiah and Abraham, 1957) also has not indicated any response to applications of potash to either paddy or sugarcane. As stated by Reitmer (1951) the non-response to application of potash may be presumably attributed to the gradual release of soluble potassium from the rich potash-bearing minerals in soils as a result of their weathering. This source of potassium may be of greater significance in meeting the plant requirements than the potassium supplied through fertilisers, which is likely to be fixed into non-available forms.

Owing to the intensive crop production drive launched in post-war years to meet the deficit through the use of fertilisers, the necessity was felt for a critical reassessment of the need for potash in manuring of cereal crops. With this objective in view experiments were started in the several Agricultural Research Stations in the State and also in the Pot Culture House on ragi (*Elusine coracana*) and paddy (*Oryza sativa*) in 1954 and the results of the same are presented in this paper.

Experimental

An experiment was designed to include the study of applications of 30 lb. K_2O with two levels of N, *viz.*, 30 lb. and 40 lb. over a common basal dose of 20 lb. P_2O_5 per acre. Treatments were four and the

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design was latin square. The experiment was conducted for four seasons at the following centres:—

(1) Agricultural Research Station, Nagenahalli, representing the sandy clay soils typical of the areas under the old channel irrigation system in Mysore District.

(2) Agricultural Research Station, Mandya, representative of the red sandy soils brought more recently under irrigation under the major channel system of the Krishnarajasagara, *viz.*, V.C. system.

(3) Agricultural Research Station, Babbur, Hiriyur, typical of the base-saturated clayey soils under the Vani Vilas Sagar command in Chitradurga District.

A 3-cubed factorial experiment in the Pot Culture House with 0,30,60 lb. of N, 0,20,40 lb. P_2O_5 and 0,30,60 lb. K_2O was conducted in one square yard embedded bottomless cement cisterns filled with red loamy soils typical of the red soils in Bangalore, Kolar and Tumkur Districts. Another experiment to study the influence of potash in combination with N and P on ragi was also conducted in $\frac{1}{2}$ square yard bottomless embedded cylinders filled with red soils. The experiment on paddy and ragi were repeated over 5 seasons including both monsoon and summer crops. The analysis of the soils of the farms and also of the Pot Culture House, the yield data from the three studies and the composition and uptake of nutrients from the Pot Culture House experiment on paddy are given in Tables I–VI.

Results

Table I

Analysis of soils

(Percentages on dry basis)

Locality	Coarse sand	Fine sand	Silt	Clay	pH	N	P_2O_5	K_2O	CaO	Avl. P_2O_5	Avl. K_2O	Ex. CaO
A.R.S. Nagenahalli	42·7	24·0	0·3	22·2	5·0	0·07	0·03	0·07	0·33	0·0031	0·005	0·20
A.R.S. Mandya	40·9	34·0	4·6	17·8	6·5	0·099	0·025	0·33	0·20	0·0014	0·035	0·12
A.R.S. Babbur	5·1	57·1	11·4	24·4	8·0	0·05	0·029	0·23	0·45	0·0054	0·03	0·29
Pot Culture House	38·9	32·4	5·9	19·7	6·9	0·06	0·05	0·09	0·22	0·0015	0·01	0·15

The soil analyses (Table I) reveal that the available potash in the soils is well over 0·0125 per cent. which is considered to be adequate except at Nagenahalli where available K as also pH is low. Extensive soil test values obtained from the analysis of soils all over the State under the soil testing programme (Gopala Rao, 1958) also reveal that most of our soils contain adequate amounts of available potash, while the soils in heavy rainfall Malnad Districts and in the west coast with a tendency for acidic reaction generally show low amounts of this constituent.

TABLE II

Yield data from the field experiments

Paddy grain in lb. per acre

Treatments	A.R.S. Nagenahalli				A.R.S. Mandya			A.R.S. Babbur			
	1954	1955	1956	1957	1954	1955	1956	1954	1955	1956	1957
30 lb. N	2523	2681	2533	2725	2330	3120	2310	2099	2395	2282	2350
30 lb. N +30 lb. K_2O	2556	3104	2883	3033	2070	2760	2110	2126	2193	2320	2320
40 lb. N	2590	2855	2867	2992	2000	3200	2190	..	..	..	..
40 lb. N +30 lb. K_2O	2760	3171	3067	3142	2110	3230	2330	2172	2130	2132	2445
C.D. at 5%	n.s	n.s.	266	301	219	255	n.s.	n.s.	n.s.	n.s.	n.s.

n.s. = not significant.

It is seen that there is a consistent trend towards increased yields of paddy (Table II) with the application of 30 lb. K_2O at both levels of N at Nagenahalli and the increase is significant in the third and fourth repetitions of the experiment. On the other hand there appears to be a consistent depression in yields with the application of potash at Mandya. The yield responses at Babbur are neither significant nor consistent in any direction. The application of potash in these soils does not seem to exert any beneficial influence as the crop needs of the same are apparently met by the higher potash contents of the soils. The beneficial trends at Nagenahalli may be attributed to the low pH and low available potash obtaining in the soil.

The yield of paddy in the plot experiments (Table III) does not show any significant response to K alone or K in combination with N or P or their interaction except in 1955 monsoon and 1956 summer experiments where there is response to interaction of NPK and for K

Table III

Yield of paddy grain from the plot experiment

(In grams per square yard)

	0 lb. N			30 lb. N			60 lb. N		
	0 lb P_2O_5	20 lb. P_2O_5	40 lb. P_2O_5	0 lb. P_2O_5	20 lb. P_2O_5	40 lb. P_2O_5	0 lb. P_2O_5	20 lb. P_2O_5	40 lb. P_2O_5
Monsoon 1954—									
0 lb. K_2O ..	482	627	611	664	637	548	773	655	693
30 lb. K_2O ..	562	527	449	706	641	599	709	579	704
60 lb. K_2O ..	556	531	559	495	706	618	672	706	535
	Significant only for N; C.D. =196								
Summer 1955—									
0 lb. K_2O ..	585	646	736	786	811	802	965	954	955
30 lb. K_2O ..	582	648	754	821	837	862	925	997	1013
60 lb. K_2O ..	656	674	638	754	865	819	942	938	1029
	Significant only for N, P; C.D=45·8								
Monsoon 1955—									
0 lb. K_2O ..	598	592	694	694	701	700	773	763	788
30 lb. K_2O ..	614	607	666	666	705	716	754	754	785
60 lb. K_2O ..	645	628	733	733	693	721	761	761	820
Summer 1956—									
0 lb. K_2O ..	415	555	570	553	610	620	678	649	608
30 lb. K_2O ..	534	540	585	595	590	626	639	615	710
60 lb. K_2O ..	535	520	610	560	655	629	640	640	679
	Significant for N, P and interaction of NPK ; C.D.=39·8								
Monsoon 1956—									
0 lb. K_2O ..	440	515	545	580	588	606	628	627	620
30 lb. K_2O ..	443	515	520	585	595	618	630	640	658
60 lb. K_2O ..	475	510	578	595	614	600	643	630	668

Significant for N, P and interaction of NP: C.D. = 65·5.

alone in the latter instance. The response of paddy is in main to N and to a certain extent P_2O_5 and their interactions, K showing no response in all the trials except one.

The samples of paddy grain and straw from 8 out of the 27 treatments representing the minimal and maximum dosages from the monsoon 1954 and summer and monsoon 1956 trials were analysed and the composition of crop and uptake of nutrients are set out in Tables IV and V.

A perusal of the analytical data (Table IV) reveals no marked variation in the composition either in regard to grain or straw in the several treatments though indications of slight increase of P and K over the control and over N are observed in all the combinations of

TABLE IV

Composition of the crop

(Percentages on dry basis)

	Monsoon 1954						Summer 1956						Monsoon 1956					
	Grain			Straw			Grain			Straw			Grain			Straw		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
1–O ..	1·17	0·57	0·71	0·48	0·22	2·53	0·98	0·55	0·72	0·42	0·32	1·85	1·06	0·63	0·71	0·43	0·24	1·91
2–K ..	1·20	0·72	0·74	0·42	0·22	2·25	1·05	0·60	0·72	0·46	0·31	1·87	1·02	0·63	0·72	0·46	0·28	2·09
3–P ..	1·22	0·78	0·71	0·47	0·27	1·56	1·00	0·56	0·50	0·45	0·30	1·83	1·04	0·65	0·69	0·42	0·26	2·08
4–N ..	1·19	0·56	0·72	0·33	0·23	2·31	0·91	0·53	0·70	0·47	0·32	2·1	1·08	0·66	0·67	0·42	0·24	1·80
5–NK ..	1·60	0·75	0·73	0·50	0·33	3·26	0·99	0·54	0·71	0·46	0·28	2·00	1·07	0·59	0·70	0·45	0·23	2·09
6–NP ..	1·20	0·59	0·71	0·42	0·40	2·00	1·09	0·61	0·73	0·49	0·33	2·2	1·07	0·68	0·70	0·49	0·29	2·09
7–PK ..	1·23	0·61	0·75	0·43	0·29	2·06	0·95	0·52	0·75	0·47	0·28	2·0	1·04	0·58	0·73	0·43	0·23	2·06
8–NPK ..	1·19	0·64	0·70	0·38	0·36	2·17	1·10	0·59	0·75	0·47	0·30	2·1	1·08	0·67	0·76	0·47	0·28	2·10

TABLE V

Uptake of nutrients in grams per square yard

(In grams per square yard)

	Summer 1954			Summer 1956			Monsoon 1956		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
1–O ..	7·50	3·35	14·96	6·87	4·17	12·68	6·58	3·80	11·62
2–K ..	8·17	4·74	15·55	8·24	4·98	14·51	7·15	4·39	13·97
3–NP ..	9·39	5·84	13·02	8·40	4·99	13·83	8·04	5·02	14·51
4–N ..	10·82	5·63	20·58	9·84	6·09	21·13	7·32	6·14	17·05
5–NK ..	13·05	6·67	24·14	9·81	5·57	19·64	10·00	5·39	19·11
6–NP ..	10·32	6·38	16·83	10·30	5·94	19·29	9·69	6·02	22·11
7–PK ..	8·60	4·69	14·33	8·92	5·13	17·75	8·59	4·73	16·58
8–NPK ..	8·50	5·60	18·04	11·82	6·38	21·68	10·91	6·95	20·91

these constituents. A study of uptake of nutrients (Table V) reveal that application of N results in increased uptake of all the nutrients, namely, N, P, K. The application of P in addition to increasing the uptake of P itself indicates a beneficial influence on N utilisation. It also seems to influence the uptake of K to some extent. Application of K does not show any consistent influence on the uptake of either N or P except that little more K is removed in the crop.

TABLE VI

Yield of ragi grain from the Pot Culture House experiment

(In grams per square yard)

Treatments	Monsoon 1954	Summer 1955	Monsoon 1955	Summer 1956	Monsoon 1956
1. N alone ..	148	475	324	114	94
2. N+K .	178	619	396	125	100
3. N+P ..	196	631	441	140	106
4. P+K ..	151	417	293	106	77
5. N+P+K	231	754	496	144	123
C.D. at 5% ..	52·5	119·2	69·0	23·0	22·6

N.B.—N = 15 lb. ; N, P = 10 lb. ; P_2O_5 and K = 15 lb. K_2O.

In contrast to the lack of response to K for paddy there are fair and consistent responses of ragi to K (Table VI) over N and NP, the same being significant in three out of the five trials.

Summary

In this paper the results are reported of: (1) eleven field experiments on the influence of potash on paddy conducted at three Agricultural Research Stations situated in different soil and climatic conditions, (2) five 3-cubed factorial experiments in one square yard embedded cement cisterns filled with red soils on the influence of three levels of K alone and in combination with three levels of N and P to ascertain their influence on yield composition and uptake of nutrients and (3) five experiments in half a square yard embedded iron cylinders filled with red soils to study the influence of K over N and NP on ragi. The field experiments on paddy in the soils obtaining in these Research Stations do not show any significant response or consistent trends to applications of K at 30 lb. K_2O level except for indications of response at Nagenahalli where the soils show an acidic reaction and low amounts of available K. Even in the micro-plot experiments in the Pot Culture House there is no indication of any consistent influence of K alone or in combination with N or P or NP at any of the levels tried on either the yields or composition of paddy or on the uptake of the nutrients. The plot experiments on ragi show fair responses to applications of moderate doses of K over N and NP.

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EFFECTS OF VARIOUS ROTATIONS ON THE COTTON CROP

By C. B. Divekar[1] and F. B. Kurtkoti[2]

Introduction

Rotation of crops is a recognised agronomic practice. Rothamsted experiments conducted from 1851–1927 on wheat (Russel, 1950) clearly illustrate the beneficial effects of crop rotations. Similar results have also been reported by Leighty (1938). Bederkar and Joshi (1954) have observed that introduction of groundnut in a cotton rotation increases the vigour of the succeeding cotton crop, hastens maturity and enhances its yields. Patel and Gopani (1941) have observed that in Broach District cotton following a crop of lang ripens early. Mahta and Janoria (1933) have said that the yield of cotton crop is influenced by the preceding crops.

Cotton is an important crop of Karnatak and has been grown in rotation with jowar since a very long time. With the introduction of groundnut in this region cotton is being grown in a biennial rotation with groundnut or jowar. It is also grown in a triennial rotation with both groundnut and jowar crops in a rotation. During the boom period of World War II there was a tendency to grow cotton continuously in some areas, which however had to be checked by enforcing " Growing of Food Crops Act ". Similarly varying practices of manuring these crops with farmyard manure, such as manuring of jowar or groundnut or cotton are in vogue. A comprehensive experiment, to study the effect of growing important crops of this region in various combinations of rotations and the application of phosphatic and farmyard manure to various crops concerned, was taken at the Agricultural Research Station, Dharwar, in 1948–49 and continued till 1957–58 in medium black soil. The present paper deals with the influence of various components of rotation on the performance of cotton crop.

Material and Methods

The experiment included the following 22 treatment combinations and was laid out in randomised blocks with 5 replications.

To assess the effects of phosphatic manuring to legumes, over no manuring, the sub-plots coming under groundnut crop were divided into two halves of 22′ × 18′ each net, one half receiving superphosphate

[1, 2] Agricultural Research Station, Dharwar.

at the rate of 100 lb. per acre prior to sowing of groundnut, while the other half did not receive superphosphate.

Treatments	Rotations			Treatments	Rotations		
A	Cm	Cm	Cm	L	G	Cm	G
B	Cm	C	Cm	M	J	G	J
C	C	Cm	C	N	G	J	G
D	Jm	Jm	Jm	O	Jm	G	Jm
E	Jm	J	Jm	P	G	Jm	G
F	Jm	J	J	Q	C	Jm	G
G	C	Jm	C	T	Jm	G	C
H	Jm	C	Jm	U	G	C	Jm
I	C	G	C	R	C	G	Jm
J	G	C	G	S	Jm	C	G
K	Cm	G	Cm	V	G	Jm	C

Abbreviations used:

Cm = Cotton manured with farmyard manure at 5 cartloads per acre.

Jm = Jowar manured with farmyard manure at 5 cartloads per acre.

C = Cotton without manure.

J = Jowar without manure.

G = Groundnut without manure.

The ploughing and other tillage operations were carried out as per normal practice in the tract. Pure seeds of groundnut *var.* SPANISH IMPROVED, Jowar *var.* NANDYAL and cotton *var.* JAYADHAR (*Gossypium herbaceum*) were used in the experiment. The spacing adopted was 12″×5–6″ for groundnut, 18″×6–8″ for jowar and 24″×12″ for cotton.

It was observed that the trend of effects of groundnut crop in cotton, with or without superphosphate applied to groundnut, were similar and hence they have been pooled for the sake of present study.

The height measurements of 5 cotton plants picked up at random in each sub-plot were recorded at three stages of crop growth, once at the age of 40–60 days, a second time at the age of 107–130 days and the final height at 180 days. This datum has been collected for three years, *i.e.*, 1954–55, 1956–57 and 1957–58.

Experimental Results

Average yields of seed cotton per acre and average percentage increase or decrease over the yield of normal cotton in jowar-cotton rotation are presented in Table I.

Table I

Yields of seed cotton in lb. per acre and the average percentage increase or decrease over the yield of normal cotton in jowar-cotton rotation experiment from 1951–52 *to* 1957–58

Treatments	1951–52	1952–53	1953–54	1954–55	1955–56	1956–57	1957–58	Average yield p.a.*	Average % increase or decrease over normal cotton
(G) C-Jm ..	..	616	..	618	..	436	..	506	Control
(H) Jm-C ..	464	..	508	..	547	..	360		
(A) Cm-Cm-Cm	436	606	367	602	495	454	292	481	− 4·95%
(B) Cm-C-Cm ..	370	587	345	565	577	341	252	449	−11·27%
(C) C-Cm-C ..	409	571	317	573	484	345	320		
(I) C-G ..	..	636	..	395	..	400	..	509	+ 0·59%
(J) G-C ..	557	..	437	..	605	..	460		
(K) Cm-G ..	..	797	..	695	..	536	..	604	+19·36%
(L) G-Cm ..	471	..	417	..	638	..	488		
(Q) C-Jm-G ..	564	..	..	762	..	..	632	668	+32·01%
(T) Jm-G-C ..	..	..	410	..	..	578	..		
(U) G-C-Jm ..	..	762	..	..	710	..	..		
(R) C-G-Jm ..	385	..	..	590	..	..	372	483	− 4·55%
(S) Jm-C-G ..	..	577	..	..	572	..	..		
(V) G-Jm-C ..	..	..	436	..	..	401	..		
Average ..	457	644	404	600	578	436	397	..	..

N.B.—The column, where (..) occurs, indicates that this plot had other rotational crop during that year.

* The yield figures of 1953–54 season have been excluded while calculating the average yield per acre.

The height measurements were recorded at intervals stated already and are furnished in Table II.

Results

(*a*) *Yield of seed cotton.*—Except experiment for 1953–54, which was not a normal year, it is seen from the average yields obtained that in the normal rotation of jowar-cotton (GH) wherein jowar is given

TABLE II

Height of cotton plants, in inches, under different rotations

(Figures are the averages of 25 random plants)

Treatments	1954—55			1956—57			1957—58		
	No. of days after sowing			No. of days after sowing			No. of days after sowing		
	77	107	180	60	108	180	42	132	180
G, H									
C-Jm ..	23·4	32·0	35·0	13·2	25·8	26·0	12·6	33·2	35·0
A									
Cm-Cm-Cm ..	22·5	34·0	35·0	11·0	25·1	26·0	13·0	32·0	33·8
B									
Cm-C-Cm ..	20·8	34·0	34·0	9·9	24·3	25·0	10·8	28·2	30·0
C									
C-Cm-C ..	19·1	31·0	34·0	9·9	22·3	25·4	11·5	30·6	32·0
I, J									
G-C ..	22·0	35·5	35·5	11·2	23·9	26·5	12·7	31·5	34·7
K, L									
G-Cm ..	25·8	36·0	38·0	15·4	27·7	29·0	13·9	36·1	37·6
Q, T, U									
C-Jm-G ..	25·0	37·0	37·0	13·4	25·4	28·0	14·9	35·1	37·2
R, S, V									
C-C-Jm ..	22·4	37·0	37·0	13·6	24·9	28·0	12·7	30·1	32·0

farmyard manure, the yield of seed cotton is more than that of cotton crop manured every year (A) or in alternate years (BC). This is also revealed in improved crop growth of cotton in the normal rotation (GH) as compared to the other two (A) and (BC).

In the biennial rotation of cotton and groundnut (I) the yields of cotton obtained are almost equal to the normal yields obtained in the cotton-jowar rotation (GH). This indicates that groundnut crop as a component of rotation with cotton is highly beneficial. The crop growth in this treatment (IJ) is also found to be almost the same as in the normal cotton, as in the cotton-jowar rotation (GH). Furthermore it is observed that application of farmyard manure to cotton in the cotton-groundnut rotation (KL) is found to increase the yield of seed cotton to the extent of about 19·36% than the cotton in the cotton-jowar rotation.

While inclusion of groundnut is found conducive to higher yields in general, a surprising observation is that when employed in a triennial rotation of groundnut-jowar-cotton (RSV) the yields are actually lower by 4·55% than that obtained in the normal cotton-jowar rotations (GH). It is to be stated, however, that when cotton succeeds the groundnut crop in the triennial rotation of cotton-jowar and groundnut (QTU) the yield of cotton is increased by nearly 32% than in the normal jowar-

cotton rotation. Hence it could be made out that by employing both groundnut and/or jowar as components in the rotation system, the yields of seed cotton could be increased than in the case when cotton is grown continuously with the application of farmyard manure.

(*b*) *General crop growth of cotton in various treatments.*—Periodical measurements of height of cotton plants were done at intervals as stated already. A perusal of Table II shows that growth is similar in the following treatments: (A) Cotton continuously cropped and manured every year, (IJ) cotton taken after groundnut and (GH) normal cotton in the cotton-jowar rotation. The growth of continuous cotton manured in alternate years (BC) is poor as compared to the normal cotton crop. The growth in both the triennial rotations (QTU and RSV) is superior. Maximum height is recorded in the cotton crop receiving farmyard manure and rotated with groundnut (KL).

Incidentally it has been observed that application of farmyard manure has a tendency in delaying maturity. The three-way rotation, where cotton follows groundnut, manure being applied to Jowar (QTU) appears to be the most suitable of all the rotations tested from the point of view of yield as well as earliness.

Discussion

Sewell (1923) and Breazeale (1924) have examined the causes of bad effects of sorghums preceding cotton crop on the yields of cotton in the U.S.A. Even though they differ in their views regarding the causes, they have substantiated the ill—effects of sorghums. Similar results have been found in India where it has been shown that cotton coming after sorghums yields about 16% less than when it follows Bajra (*Pennisetum typhoides*). Ayyar and Sundaram (1941) at Coimbatore in India have also shown similar effects, which they were unable to attribute to any particular factor. They consider that the accumulation of replaceable sodium ions in the superficial soil layers, found prominently in plots sown to jowar as compared with these sown to Bajra, was the probable cause of retarded growth in the early phase of cotton and its consequent low yields.

Mahta and Janoria (1933) have studied groundnut-cotton rotation and found a remarkable increase in the yield of cotton by rotating it with groundnut as compared to the one with sorghum in the two-way rotation. They have also shown a high decline in yield when cotton is taken continuously, the reduction being decreased when groundnut is taken once in three years, *i.e.*, cotton, cotton-groundnut.

The results obtained in the present investigations with JAYADHAR cotton (*Gossypium herbaceum*) on the whole confirm the findings of Mahta and Janoria.

The Jowar-groundnut-cotton totation (QTU) is found to give 32·0% more yield of seed cotton than that in the normal jowar-cotton rotation. The rotation of groundnut, jowar and cotton (RSV) has yielded 4·55% lesser yield than that in the normal rotation, even though jowar preceding cotton was manured with farmyard manure. This may be due to the fact that the jowar crop, prior to cotton, was able to grow better on account of the previous crop of groundnut, resulting in turn accumulation of greater harmful effects of sorghum in the soil resulting in low cotton yields (Ayyar and Sundaram, 1941).

Summary

1. Possibility of successfully introducing groundnut in rotation with cotton under the rain-fed conditions of Dharwar and utilisation of groundnut in two-way rotations with cotton has been investigated.

2. (*a*) Cotton yield in continuous cotton manured in alternate year is found to yield lower by 11·27% per year as compared to the normal cotton in jowar-cotton rotation.

(*b*) When continuous cotton is manured every year with farmyard manure the reduction in seed cotton yield is only 4·95% as compared to the cotton in the normal rotation.

3. Groundnut can be used in a two-way rotation with cotton without detriment to the cotton yields.

4. Utilisation of groundnut appears to avoid ill-effects of jowar on cotton and at the same time saves farmyard manure required to be applied to jowar in the jowar-cotton rotation.

5. Manuring cotton in groundnut-cotton rotation gives 19·36% more yield of seed cotton with the same expenditure of manure as in the normal jowar-cotton rotation.

6. In a three-way rotation of groundnut-cotton-jowar, the cotton yields are higher by 32·01%, when cotton succeeds groundnut as compared to the normal cotton yields. However, jowar preceding cotton is found to be detrimental to cotton yields even though groundnut is included in the rotation.

Acknowledgements

The authors take this opportunity to express their deep regards to Dr. H. R. Arakeri, Joint Director of Agriculture, Bangalore, Professor U. K. Kanitkar, Cotton Physiologist, College of Agriculture, Dharwar and Shri D. V. Murthy, Assistant Editor, for their sincere advice and guidance during the preparation of the manuscript. Sincere appreciation is also due to Shri B. B. Yeligar. Deputy Director of Agriculture, Dharwar Division, Dharwar, for providing necessary facilities.

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APPENDIX I

Rainfall in inches from 1951–52 *to* 1957–58, *at the Agricultural Research Station, Dharwar*

Year	Pre-monsoon April–May	Monsoon June–Sept.	*Rabi* Oct.–Mar.	Total rainfall in inches
1951–52 ..	7·68	17·09	5·04	29·81
1952–53 ..	6·01	16·07	6·96	29·04
1953–54 ..	1·36	21·87	13·06	36·29
1954–55 ..	3·77	16·66	5·34	25·77
1955–56 ..	8·50	16·12	5·59	30·21
1956–57 ..	4·15	16·34	11·71	32·20
1957–58 ..	9·42	19·91	9·55	38·88

A NOTE ON THE INCIDENCE OF SOME IMPORTANT INSECT PESTS OF COTTON AT THE AGRICULTURAL COLLEGE FARM, DHARWAR

By S. S. Katagihallimati*

I. Introduction

Cotton is one of the most important crops in Northern Mysore and account for nearly 55% area under cotton in the reorganised Mysore State. A number of insect pests occur annually on this important crop and many a time cause very severe reductions in the yields. Between the years 1947–51, the writer undertook a survey of insects infesting the cotton crop in North Mysore, during which the following 22 insects and mites were recorded as occurring on cotton:—

(1) *Empoasca devastans* Dist. (Jassidæ: Hemiptera).

(2) *Thrips tabaci* Lind. (Thripidæ: Thysanoptera).

(3) *Eriophyes* sp. (Arachinida).

(4) *Aphis gossypii* G. (Aphididæ: Hemiptera).

(5) *Anomis* sp. (Noctuidæ: Lepidoptera).

(6) *Myllocerus* sp. (Curculionidæ: Coleoptera).

(7) *Earias fabia* and *Earia insulana* (Noctuidæ: Lepidoptera).

(8) *Platyedra gossypiella* S. (Gelchidæ: Lepidoptera).

(9) *Sylepta derogata* F. (Pyralidæ: Lepidoptera).

(10) *Diacrisia obliqua* (Arctiidæ: Lepidoptera).

(11) *Amsacta* sp. (Arctiidæ: Lepidoptera).

(12) *Sphenoptera gossypii* K. (Buprestidæ: Coleoptera).

(13) *Pempherulus affinis* F. (Curculionidæ: Coleoptera).

(14) *Phycita infusella* M. (Pyralidæ: Lepidoptera).

(15) *Monolepta signata* Ol. (Chrysomelidæ: Coleoptera).

(16) *Zonabris pustulata* T. (Meloidæ: Coleoptera).

(17) *Chrotogonus* sp. (Acridiidæ: Orthoptera).

(18) *Laphygma exigua* H. (Noctuidæ: Lepidoptera).

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(19) *Pseudococcus virgatus* C. (Coccidæ: Hemiptera).

(20) *Dysdercus cingulatus* Fb. (Pyrrhocoridæ: Hemiptera).

(21) *Oxycarenus lætus* K. (Lygæidæ: Hemiptera).

(22) *Trifidaphis gossypii* sp. nov. (Aphididæ: Hemiptera).

Later on between 1953 and 1956, intensive studies were carried out on the incidence and seasonal occurrence of some of the important insect pests and a brief report thereof is presented in the following pages.

II. Material and Methods

From 1953–56 incidence of the insects were recorded on '*Laxmi*' cotton (*Gossypium hirsutum*) at the Agricultural College Farm, Dharwar. The insects found in any stage on experimental *Laxmi* cotton crop were brought to the laboratory and reared. In some cases the laboratory rearing helped to verify whether insects collected from the cotton crop were able to breed on it or not, or were merely stray visitor in their course of migration from one crop to another.

Three different sized leaves from each plant were chosen for the purpose, namely, (1) small and tender leaf, (2) medium and middle leaf and (3) old and lower leaf. Insects were actually counted on both sides of leaves without disturbing them. The average population per leaf was calculated after averaging the counts made on these three leaves. The ultimate figure of average population per leaf was arrived at after examining 60 plants selected at random. The counts of thrips, jassids, red mites and aphids were taken and tabulated. The population count per plant for semiloopers and myllocerus weevils were taken on 60 plants selected at random and then the average was struck. For calculating the incidence of bollworms the total number of shoots, buds and bolls were counted in a plant and then the percentage of attack was calculated on the average of 60 plants.

III. Results

The observations recorded are given in Table I.

A perusal of Table I reveals that the cotton crop in its early vegetative growth period is attacked by a group of sucking insects such as jassids (*Empoasca devastans* D.), Thrips (*Thrips tabaci* L.), Aphids (*Aphis gossypii*) and mites. Myllocerus weevils, Semiloopers (*Cosmophila* sp.), Bud worms (*Phycita infusella* M.) and surface grasshoppers (*Chrotogonus* sp.) are also found infesting the crop during this period, but their incidence is sporadic and short-lived. During the latter stage of the life of the crop, however, spotted bollworms (*Earias* sp.), red cotton bug (*Dysdercus cingulatus*) and dusky cotton bug (*Oxycarenus*

TABLE I

Table showing the incidence of some insect pests on Gossypium hirsutum *on Dharwar Farm during* 1953–54, 1954–55 *and* 1955–56

Date of observation	Average insect population per medium-sized leaf				Average insect population per plant		Percentage of attack by bollworms (shoots, buds and bolls)
	Thrips	Jassids	Red mites	Aphids	Semiloopers	Myllocerus weevils	
			1953—54				
15—9—1953 ..	42·2	1·60	0·10	0·20	0·0	0·3	0·0
29—9—1953 ..	11·5	1·50	0·02	1·05	0·0	0·6	0·0
20—10—1953 ..	1·25	1·90	0·04	0·95	0·0	0·33	0·0
14—11—1953 ..	0·67	0·32	0·29	9·46	0·0	0·8	0·0
9—12—1953 ..	0·12	0·04	3·70	23·20	0·0	0·0	..
26—12—1953 ..	0·74	0·40	4·41	57·28	..	..	..
16—1—1954 ..	0·83	0·00	3·95	14·23	0·0	..	27·0
30—1—1954 ..	2·86	0·00	2·31	3·74	0·0	0·0	10·0
22—2—1954 ..	1·41	0·00	0·80	12·24	0·0	0·0	9·97
9—3—1954 ..	0·58	0·00	0·00	0·00	0·0	0·0	0·0
			1954—55				
18—9—1954 ..	11·2	1·1	3·6	2·5	1·0	0·4	0·0
30—9—1954 ..	7·6	1·7	2·4	3·3	1·4	1·6	0·0
15—10—1954 ..	1·6	1·2	3·2	2·8	1·5	1·8	0·03
30—10—1954 ..	8·25	9·2	4·9	14·6	1·9	..	0·2
14—11—1954 ..	1·67	1·32	9·3	51·1	2·2	0·9	8·6
30—11—1954 ..	13·3	1·8	10·50	46·0	..	1·4	12·1
15—12—1954 ..	3·67	0·41	13·3	28·5	..	0·7	18·0
28—12—1954 ..	6·28	1·3	7·8	22·4	0·0	0·0	14·0
13—1—1955 ..	0·88	0·5	2·6	8·2	0·0	0·0	7·2
			1955—56				
16—9—1955 ..	29·4	2·1	1·0	1·6	3·8	0·6	0·0
28—9—1955 ..	8·8	2·3	1·9	2·5	4·6	1·2	0·03
16—10—1955 ..	6·0	4·5	1·2	5·8	6·2	1·1	0·1
28—10—1955 ..	1·8	2·8	2·9	3·6	4·3	1·3	0·3
15—11—1955 ..	2·6	1·9	4·1	21·3	3·3	0·8	6·0
30—11—1955 ..	4·2	1·5	7·4	27·4	2·1	0·0	8·1
15—12—1955 ..	1·7	1·3	6·3	30·6	1·2	..	11·3

lætus) appear in considerable numbers. These observations would be helpful for evolving a schedule of control measures against different insect pests on cotton at one time and also help to a certain extent to predict the possibility of the occurrence of the various pests.

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HAZARDS TO POTATO CROP IN THE SOIL

By D. Seshagiri Rao*

Apart from the pests to which potato crop is subject above the ground, several pests injure it inside the soil. A proper appreciation of the effect of these animal pests on the crop does not appear to have been realised. In this note the common underground pests and the nature of their damage on potato will be briefly dealt with.

1. In an earlier note[1] (Seshagiri Rao, 1957) an instance of serious damage inflicted by the red ant *Solenopsis geminata* F. to tubers was recorded. The ants had tunnelled right up to the core of the tubers in some cases, and these tubers had became shapeless, spongy, dry and quite useless. The soil was light with an admixture of sand and was quite dry for some days.

During a visit to Ramakrishna Krishi Shala (R. K. Shala) 18 miles from Bangalore in June 1958, it was noticed that sprouting of Potato planted on 2–6–1958 and 5–6–1958 was poor, being only about 25%. On examination it was noticed that the ' bits ', were found damaged by red ants, which had bored a short distance into the bit. Many of the bits sprouted late and eventually there was about 50% germination.

The soil in the area is light red, dry and friable.

2. Similar to the injury by the red ant, was the damage to the planted ' bits ' in certain patches by termites, specially where pieces of straw and other dry matter brought in with farmyard manure had accumulated in the soil. The termites had tunnelled into the bits on the same way as the red ants.

3. At the subsequent examinations on the 12th and 28th July 1958, it was observed that in the blank places the original potato bits had become soft and crumpled; there was a heavy infestation of mites and eelworms on them, probably soil forms, attracted to the decomposing potato bits (*see* Fig. 1).

4. During harvest, damage from root grubs becomes apparent. This was not evident in R. K. Shala plots, but in the laboratory plots, fairly advanced stages of cockchafer grubs were in the soil directly under the plants, gnawing away at the tubers. Almost the entire tuber had been eaten in some plants (*see* Fig. 2). The extent of damage

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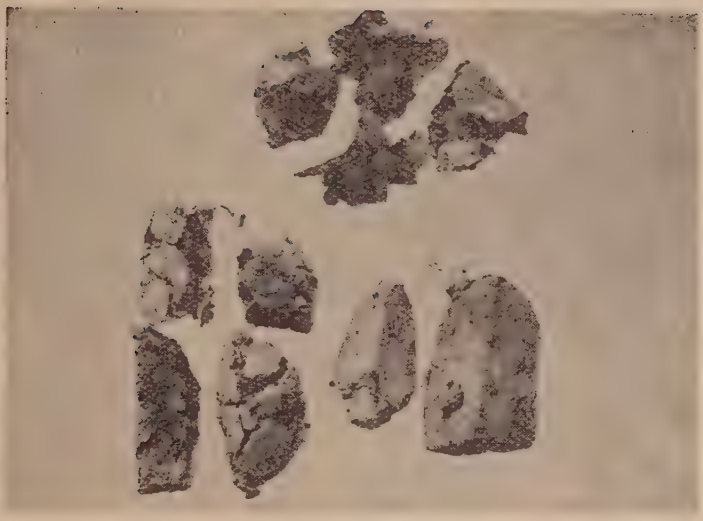

FIG. 1

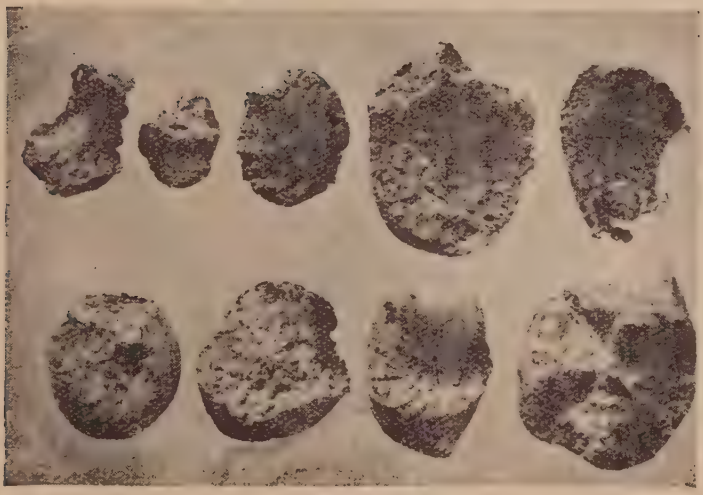

FIG. 2

could be gauged from the fact that in one small sub-plot, while the total weight of sound tubers harvested was 156 grams, damaged tubers weighed 260 g. Since damaged tubers are not marketable the seriousness of the loss can be imagined.

Thus the potato crop is subject to serious injury by various soil pests. Termites and root grubs may be traced to the farmyard manure, while the red ants seem to favour certain soils. The nematodes and mites might be soil forms, seen in abundance in rotting potato ' bits ' initially attacked by Termites and red ants. All these together can lower the germination by 50%, while the root grubs can inflict substantial injury after the formation of the tubers.

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EFFECTS OF VARIOUS ROTATIONS ON JOWAR

By B. B. Yeligar,[1] F. B. Kurtukoti[2] and C. B. Divekar[3]

Introduction

Crop rotation is the easiest, most effective and no doubt the cheapest method of maintaining soil fertility and high yields. Crop sequence is the key to successful crop-rotation. Various crops are known to leave certain after-effects which are either beneficial or injurious to the growth of subsequent crops.

Sewell (1923) in the U.S.A., has listed five possible causes of injurious effects of sorghums on the succeeding crops, *viz.*, depletion of minerals, toxic root excretions, toxic products of decay, diseases associated with the crop and the effect of soil protozoa and other micro-organisms. Ayyar and Sundaram (1941) in India, consider that the accumulation of replaceable sodium ions in the superficial soil layers in jowar plots as the cause of retarded growth of subsequent cotton crop and its consequent low yields. Legumes, from time immemorial are known to reinvigorate soils. Lyon (1936) and Bederker and Joshi (1954) have shown beneficial effects of leguminous crops on succeeding non-leguminous crops.

An experiment which included the three important crops of Dharwar tract, *viz.*, Jowar, Groundnut and Cotton in various combinations of rotations was taken up at the Agricultural Research Station, Dharwar, in the medium black soil in 1948–49 and continued till 1957–58. The object of the present paper is to point out some of relevant data obtained on the effects of preceding crop on the jowar crop.

Materials and Methods

The experiment included the following 22 treatment combinations and was laid out in randomised black with 5 replications.

In order to assess the effects of phosphatic manuring to legumes, over no manuring, the sub-plots coming under groundnut crop were divided into two halves of 22″×18″ each net, first half receiving superphosphate at 100 lb. per acre prior to sowing of groundnut, while the other half did not receive superphosphate.

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Treatments	Rotations			Treatments	Rotations		
A	Cm	Cm	Cm	L	G	Cm	G
B	Cm	C	Cm	M	J	G	J
C	C	Cm	C	N	G	J	G
D	Jm	Jm	J m	O	Jm	G	Jm
E	Jm	J	Jm	P	G	Jm	G
F	J	Jm	J	Q	C	Jm	G
G	C	Jm	C	T	Jm	G	C
H	Jm	C	Jm	U	G	C	Jm
I	C	G	C	R	C	G	Jm
J	G	C	G	S	Jm	C	G
K	Cm	G	Cm	V	G	Jm	C

Abbreviations used:

Cm = Cotton manured with farmyard manure at 5 cartloads per acre.
Jm = Jowar manured with farmyard manure at 5 cartloads per acre.
C = Cotton without manure.
J = Jowar without manure.
G = Groundnut without manure.

Pure seed of groundnut *var.* SPANISH IMPROVED, jowar *var.* NANDYAL and cotton *var.* JAYADHAR (*Gossypium herbaceum*) were utilised in the experiment. The spacing adopted was 12″×5–6″ for groundnut, 18″×6–8″ for jowar and 24″×12″ for cotton. Tillage operations were carried out as per normal practice in the tract.

Experimental Results

Average grain yield of jowar per acre and the average percentage increase or decrease over the yield of normal jowar in the jowar-cotton rotation are presented in Table I. Although the experiment commenced from 1948–49, the yield data is presented from 1951–52 only to truly represent the effects of various rotations, and particularly the triennial rotations, on the performance of jowar crop.

The average fodder yield of jowar per acre in various rotations and the average increase or decrease over the fodder yield of normal jowar in the jowar-cotton rotation from 1951–52 to 1957–58 has been presented in Table II.

TABLE I

Grain yield of jowar in lb. per acre and the average percentage increase or decrease over the yield of normal jowar in the jowar-cotton rotation from 1951–52 *to* 1957–58

Treatment	1951—52	1952—53	1953—54	1954—55	1955—56	1956—57	1957—58	Average yield per acre*	Av. % increase or decrease over normal Jowar
(G) C-Jm	1393	..	839	..	1619	..	880	1310	Control
(H) Jm-C	..	1683	..	1853	..	903	..		
(D) Jm-Jm-Jm	1237	1411	956	1771	1656	939	1201	1310	0·0 %
(E) Jm-J-Jm	1099	1251	660	1776	1243	582	1045	1073	−18·09%
(F) J-Jm-J	1041	1228	743	1499	1223	614	1020		
(M) J-G-J 1	..	2068	..	2013	..	1100	..	1634	+24·73%
(N) G-J-G 1	1729	..	1001	..	2099	..	1430		
(M) J-G-J 2	..	2191	..	1987	..	920	..	1536	+17·25%
(N) G-J-G 2	1688	..	915	..	1794	..	1259		
(O) Jm-G-Jm 1	..	2167	..	1925	..	1176	..	1753	+33·81%
(P) G-Jm-G 1	1894	..	1347	..	1982	..	1782		
(O) Jm-G-Jm 2	..	2213	..	2167	..	1344	..	1780	+36·10%
(P) G-Jm-G 2	1872	..	1069	..	2153	..	1639		
(Q) C-Jm-G 1	..	2345	..	..	1916	..	..	1540	+17·55%
(T) Jm-G-C 1	1383	..	..	1760	..	..	1023		
(U) G-C-Jm 1	..	..	1177	..	..	1175	..		
(Q) C-Jm-G 2	..	2156	..	..	1821	..	..	1518	−15·87%
(T) Jm-G-C 2	1435	..	..	1650	..	..	1117		
(U) G-C-Jm 2	..	..	1212	..	..	1237	..		
(R) C-G-Jm 1	..	..	1562	..	..	1709	..	2120	+61·83%
(S) Jm-C-G 1	1925	..	..	2420	..	..	1661		
(V) G-Jm-C 1	..	3109	..	..	2457	..	..		
(R) C-G-Jm 2	..	..	1457	..	..	1652	..	2038	+55·57%
(S) Jm-C-G 2	1982	..	..	2530	..	..	1600		
(V) G-Jm-C 2	..	2700	..	..	2347	..	..		
Average ..	1556	2043	1078	1946	1851	1112	1305	..	..

N.B.—The column where (. .) occurs, indicates that this plot had other rotational crop during that year.

* Similar plots such as EF, MN, OP, QTU and RSV have been pooled while calculating the averages.

GRAIN YIELD OF JOWAR

It is seen from the average yields per acre in Table I, that in the normal rotation of jowar and cotton (GH) wherein jowar is given farmyard manure, the grain yield is more than that of continuous jowar

TABLE II

Fodder yield of jowar in lb. per acre and the average percentage increase or decrease over the yield of normal fodder in the jowar-cotton rotation from 1951–52 *to* 1957–58

Treatment	1951—52	1952—53	1953—54	1954—55	1955—56	1956—57	1957—58	Average yield per acre*	Av. % increase or decrease over normal fodder
(G) C-Jm ..	6389	..	3542	..	5632	..	2651	5080	Control
(H) Jm-C ..	..	5280	..	7304	..	4763	..		
(D) Jm-Jm-Jm	4235	4620	4136	5456	4049	4609	3080	4312	−15·1 %
(E) Jm-J-Jm ..	3410	4400	3025	4510	4114	3685	2805	3788	−25·52%
(F) J-Jm-J ..	3465	4015	3058	4939	4796	3740	3080		
(M) J-G-J 1 ..	..	7920	..	8052	..	6314	..	6820	+34·2 %
(N) G-J-G1 ..	7260	..	5038	..	7964	..	5192		
(M) J-G-J 2 ..	..	6490	..	8668	..	5478	..	6137	+20·8 %
(N) G-J-G 2 ..	6820	..	4532	..	6732	..	4240		
(O) Jm-G-Jm 1	..	6600	..	9372	..	8712	..	8025	+57·9 %
(P) G-Jm-G 1	8810	..	6996	..	8778	..	6908		
(O) Jm-G-Jm 2	..	6710	..	9086	..	6710	..	7203	+41·7 %
(P) G-Jm-J 2	7370	..	6666	..	8052	..	5830		
(Q) C-Jm-G 1	..	7370	..	..	7106	..	..	6222	+22·4 %
(T) Jm-G-C 1	6600	..	..	7084	..	..	3190		
(U) G-C-Jm 1	..	..	5456	..	..	6754	..		
(Q) C-Jm-G 2	..	6820	..	..	6908	..	..	6122	+20·5 %
(T) Jm-G-C 2	6270	..	..	7502	..	..	3542		
(U) G-C-Jm 2	..	..	5368	..	..	6446	..		
(R) C-G-Jm 1	..	..	7546	..	..	9834	..	8310	+63·5 %
(S) Jm-C-G 1	7260	..	..	10274	..	..	5940		
(V) G-Jm-C 1	..	8800	..	..	8514	..	..		
(R) C-G-Jm 2	..	..	7004	..	..	7744	..	7742	+52·4 %
(S) Jm-C-G 2	7040	..	..	9306	..	..	5654		
(V) G-Jm-C 2	..	9350	..	..	8096	..	..		
Average ..	6244	6535	5197	7629	6728	6232	4342	..	..

N.B.—The column where (. .) occurs, indicates that this plot had other rotational crop during that year.

* Similar plots such as EF, MN, OP, QTU and RSV have been pooled while calculating the averages.

manured in alternate years (EF). However, normal yields of jowar could be obtained by manuring continuous jowar every year (D).

As stated earlier, half of the plot under groundnut crop (1) was given superphosphate at the rate of 100 lb. per acre, while the other half

(2) did not receive superphosphate. To assess the effects of phosphatic application to groundnut, the succeeding crops coming after groundnut were harvested separately from portions 1 and 2.

It is seen that by introducing groundnut as a component of rotation with jowar, in the biennial rotation, there is an increase of about 20% in the grain yield (MN) over the normal jowar yields (GH). In this jowar-groundnut rotation (MN), both the crops do not receive farmyard manure. Further, in a similar rotation of jowar and groundnut when farmyard manure is applied to jowar (OP), the increase in the grain yield of jowar is to an extent of 34·9%. This indicates that groundnut as a rotational crop plays a very important role.

It is observed from the triennial rotations (QTU, RSV) that the crop coming immediately after groundnut derives maximum benefits in the form of higher yields. The jowar grain yields are maximum in the triennial rotation (RSV) wherein jowar is taken after groundnut. The increase in the grain yield is observed to be to the extent of 58·7% over the normal yields. in cotton groundnut-jowar rotation. However, when cotton crop intervenes between groundnut and jowar (QTU), the increase in grain yield is only 61·71%.

Fodder Yields of Jowar

The fodder yields in continuous jowar manured with farmyard manure either every year (D) or in alternate years (EF) are lower than that in the normal jowar in the jowar-cotton rotation. The decrease in yield is to the extent of 15·1% in jowar manured every year (D) and 25·52% in jowar manured in alternate years (EF).

It is seen that the fodder yields in various biennial and triennial rotations show similar performance as is observed in the grain yields. In the two-way rotation of jowar and groundnut (MN) the increase in the fodder yield over normal yield is 27·5%. When farmyard manure is applied to jowar in this rotation (OP) the increase in yield is 49·8%. Similarly in the triennial rotation of cotton-groundnut-jowar (RSV) the increase in the fodder yield is 57·9%. However in the cotton-jowar-groundnut rotation (QTU) the increase over the normal fodder yield is only 21·4%.

Thus it could be seen that groundnut crop is able to influence the succeeding crop to a very great extent.

Effects of Phosphatic Fertilisation on Groundnut

The effects of phosphatic fertilisation on groundnut on the succeeding crop of jowar are seen in Tables I and II. The differences in the grain and fodder yields in portions 1 and 2 in treatments MN, OP,

QTU, RSV, indicate the residual effects of phosphatic fertilisation to groundnut. It is seen from the tables that the phosphatic application to groundnut is able to increase the grain and fodder yield of the succeeding crop to some extent. The effects are more pronounced when jowar is taken immediately after groundnut and are found to diminish when cotton crop intervenes between groundnut and jowar.

Discussion

Sewell (1923) and Breazeale (1924) have substantiated the ill-effects of sorghums on the succeeding crop. Ayyar and Sundaram (1941) have also illustrated the harmful effects of sorghums on the succeeding crop. It appears from the present study that the harmful effects of sorghums are equally harmful to the succeeding sorghum itself and this could be seen from the low yields of jowar grain and fodder in jowar after jowar rotation (DEF) as compared to the normal jowar yields in the jowar-cotton rotation.

Mahta and Janoria (1933) have observed a remarkable increase in the yield of cotton by rotating it with groundnut as compared to the one with sorghums. Welton *et al.* (1924) observed high nitrogen content in soil after potato than after cropping with corn which they attribute as the reason for high yields of wheat after potato than that after corn. The increased nitrogen content of soil was due to relatively small amount of nitrogen removed by the potato crop and also due to greater rest to the soil after potato. Ripley (1941), however, does not agree to this view with regard to the potato crop. He observes high nitrogen content of soil after alfalfa, red clover and summer fallow. The high yields of jowar obtained in the present study when jowar followed groundnut crop in the biennial (MN, OP) and triennial (QTU, RSV) rotations is probably due to the greater nitrogen content of soil in the groundnut cropped plots.

The jowar yields are found to be maximum in the jowar-cotton-groundnut (RSV) rotation and give on an average 58·70% more grain and 57·9% more fodder yield over the normal jowar yield in jowar-cotton rotation

Summary

1. The effects of preceding crops on the jowar crop were investigated.

2. Yields in continuous jowar crop manured with farmyard manure in alternate years is found to give 18·09% lesser grain yield and 25·52% lesser fodder yield per acre as compared to the normal jowar yields in "jowar-cotton" rotation. However, yearly manuring of continuous jowar with farmyard manure is able to make good the loss in

the grain yields only and the fodder yield is reduced to 15·1% as compared to the normal yields.

3. Groundnut could be used with advantage as a rotational crop with jowar.

4. Utilisation of groundnut in the biennial rotation with jowar gives 20·9% more grain and 27·5% more fodder yields and besides, saves farmyard manure required to be applied to jowar in the jowar-cotton rotation.

5. Manuring jowar in groundnut-jowar rotation gives 34·9% more grain and 49·8% more fodder yield with the same expenditure of manure as in the normal jowar-cotton rotation.

6. In a three-way rotation the jowar yields are maximum when jowar is taken after groundnut crop. In such a rotation the increase in the grain and fodder yield amounts to 58·7% and 57·9% respectively.

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General and Review Articles

PROBLEMS OF STORAGE OF GRAINS

By D. Seshagiri Rao[1]

I. Introduction

Storage of grains for food and seed purposes is not a recent innovation; it is probably as old as agriculture itself. Grain crops being seasonal the yield got in any season had to be preserved till the next harvest; scarcity pockets had to be fed by surplus areas and lean years to be provided for. Thus storage and movement of grains came into the picture, and suitable techniques were evolved to suit conditions, resources, and needs of different areas. A definite pattern of trade in grains followed as a matter of course.

Methods of storage and preservation of grains (and other agricultural commodities) having the sanction of time and experience behind them were developed to serve the needs of farmer, householder, and trader, in different regions of the country. In 1942 and succeeding years the country faced an acute deficit in foodgrains, which led Government to take over the import, procurement, storage and distribution of foodgrains on a monopoly basis. Indigenous storage practices were found inadequate to protect the large stocks that came into the hands of Government. A storage organisation was therefore mobilised at the Centre and in the States for this purpose. Though Government monopoly in foodgrains has now ceased, this machinery continues to exist on a modified scale and is working towards the application of scientific principles in this field. The notable advances made in storage entomology in the last decade and a half will be briefly reviewed in this note.

II. Problems of Storage

The causes for deterioration and spoilage of grains (and processed products) are mainly three, *viz.*,

(*a*) *dampness*, which encourages growth of moulds and bacteria leading to discolouration and heating of grains.

(*b*) *insects*, which feed and breed on grains reducing them to husk, fragments and powder.

(*c*) *rodents*, which eat up the foul grains with their droppings.

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Successful storage practice, therefore, implies the use of (1) dry, airy, damp-proof premises or receptacles, (2) dry, sound (*i.e.*, free from insect infestation) grains and (3) rat-proofing devices. These are essential pre-requisites in addition to which vigilant attention is necessary to prevent the insidious entry of these factors inimical to grains. Thus proper storage presupposes (*a*) initial optimum conditions relating to premises (and receptacles) and stocks, (*b*) periodical inspection and treatment and (*c*) salvaging and disposal.

III. Commodities in Storage

In the present context grains include (1) whole grains meant for seed and food purposes, such as cereals, millets and pulses, (2) dehusked and processed grains like rice and dhal and (3) milled products, *viz.*, *soji*, *atta*, *maida*, flour, brokens, etc. These notes also apply generally to certain categories of agricultural produce like oilseeds, chillies, spices and nuts, though the specific requirements of any of these items may vary.

(1) Seed grains have to retain their viability or germinating power. They need air for respiration and so it is necessary to provide for ventilation. Bulk storage bins are not suited for prolonged storage of seed grains. Grains attacked by insects or fungi do not germinate, so it is quite necessary to prevent insect or fungal attack on seed grains.

(2) Moisture content (M.C.) of grains is a very important factor in storage. Below 8% M.C. the grain is entirely free from insect attack, and up to 10% is a safe limit. From 12–14% it is favourable to insect life. Upwards of 14% fungal infection gains the upper hand. To keep down moisture content within permissible limits the grain should be well dried before storage in the sun, if possible, otherwise by aerating it in thin layers in the shade.

We have seen above that dry grain can take up moisture from humid air. To prevent this and the consequential danger of insect and fungal attack, free circulation of air by proper ventilation should be ensured. This however is not sufficient particularly in the wet season. The stock should be frequently inspected to detect signs of ' heating ', (*i.e.*, local rise in temperature due to insect activity) and mouldy patches. Affected portions should be immediately segregated and the remaining portion aerated and put back in storage.

(3) Processed products, *i.e.*, rice (raw and parboiled), dhal, brokens, soji, bran and flours, etc., present their own problems. In wholegrains the outside husk or seed-coat affords a natural protection. This is lacking in milled stuff. *This automatically reduces their storage life.* Thus rice is not normally suitable for storage beyond four months.

(It is preferable to store paddy, rather than rice, though other issues like storage space, transport costs and milling facilities may arise.) Prolonged storage of rice brings about a slight yellowing in colour, a reduction in nutritive value (besides the loss of vitamins and the germ due to excess polishing), a loss of weight (the cooked rice being light in the stomach) besides being reduced to powder and fragments by the weevil, subsequently attracting other pests (*Tribolium*, etc.) also. Highly polished rice is slightly less attractive to store pests than less polished rice probably because of the ' bran ' on the latter, an advantage which is nullified by the removal of the germ and vitamins in the former.

Similarly *maida* (6 months) and *atta* (3 months) have a limited storage life. The smaller particle size of these products exposes a correspondingly larger surface to insect attack (*Tribolium*, *Corcyra*, etc.). It is not possible to separate insect fragments, eggs, cast skins, webbings and frass (droppings), etc., from the material by mechanical methods such as seiving. Sun-drying or even aerating in the shade in thin layers is precluded. Care should be taken to see that dirt and dust do not get mixed up by bad handling. While the slightly higher moisture content of these products is allowed to remain, it is extremely important to ensure that they are not subjected to excess moisture, as it will result in their getting caked up into hard masses. These products when affected by store pests and microflora become rancid, have a musty odour, a bitter taste and an off flavour. when cooked.

Storage of milled products is therefore a serious and exacting problem. Other considerations permitting, it is preferrable to store whole grains rather processed products.

IV. Insects and Mites Affecting Stored Grains

Store insects belong principally to two orders, *viz.*, Lepidoptera (moths and butterflies) and Coleoptera (beetles). Insects either bore into whole grains reducing them to fragments, husk, powder, and dust or scrape away nutritive layers (scrapers). On milled products (*soji*, *maida*, *atta*, flour, etc.) the effect of insect attack is not only to bring about loss in quantity, but also to reduce the nutritive value of the stuff and in bad cases to render it unfit for consumption because of its rancidity, bitter taste and off-flavour and the admixture of droppings, insect fragments, cast skins, etc. Mites are a serious menace in food stocks stored in moist dark places for prolonged periods. They are particularly bad on flours (*atta*, *maida*, *soji*, etc.) and on account of their extremely minute size are not easily noticed.

Although there are a large number of insect and mite species associated with stored grains, the following are the most important ones.

1. *Coleoptera—Beetles*

(i) *Calandra* (*Sitophilus*) *oryzæ*.—' Rice weevil' attacks whole cereals including rice, wheat and jowar.

(ii) *Rhizopertha dominica*.—' Borer beetle'—as above.

(iii) *Trogoderma granaria*.—' Khapra beetle ' damages wheat (rarely found in the South).

(iv) *Tribolium* spp.—' Flour beetle ' infects broken grain and milled products.

(v) *Silvanus* (*oryzæphilus*) *surinamensis*.—' Saw-toothed grain beetle' found principally in rice.

(vi) *Bruchus* spp. 'Pulse beetle ' attacks pulses (whole).

2. *Lepidoptera—Moths*

(vii) *Sitotroga cerealella*.—' Paddy moth ' attacks paddy and jowar.

(viii) *Corcyra cephalonica*.—' Rice moth ' infests a large variety of stored products.

(ix) *Plodia interpunctella*.—' Indian meal moth ' attacks flour and other milled products.

(x) *Tyroglyphus* sp.— ' Mite ' especially bad on flours. There is no space here to go into the appearance, life-history and characteristics of these forms. They have a short life-cycle and a high fecundity and so multiply very rapidly especially in warm humid weather.

V. Rodents

Rodents are man's worst vertebrate enemies since the dawn of civilization, working ceaselessly to destroy and foul his stores, to damage his structures and to transmit diseases. As a class they are equipped with sharp front teeth (incisors) which continue to grow as they wear out which enables them to burrow into soil, walls, and foundations and to gnaw through woodwork. They are nocturnal animals carrying on their destructive activity under cover of darkness. Drains and sewers are their favourite haunts during day-time in cities and towns.

Rodents may be broadly grouped into:

(*a*) *Rats* (*Rattus rattus*).—' Black rat ' which is essentially a climber nesting in houses and trees and *R. norvegicus* (brown rat) which prefers to burrow underground and live in drains.

(*b*) *Bandicoots* (*Nesokia bandicota*) heavily built, with coarse, sparse hair.

(*c*) *Mice* (*Mus* spp.).—Small forms with soft fur.

Rodents burrow, climb or gnaw their way into stores, and spoil much more than they consume by spilling and fouling. Rat-proofing of stores, trapping, baiting and gassing are common methods of control.

VI. Storage Techniques

Space permitting, it is better to stack different commodites in separate rooms. On no account should several commodities be mixed up in the same stack. Similarly good grains should never be mixed up with infested grains in the same stack.

In the case of prolonged storage, the floor and each layer of the stacks should be lightly dusted with 5% BHC or DDT dust. This dusting should be renewed every six weeks at least. Four to eight ounces of dust per 100 sq. feet of surface area will suffice.

VII. Godown Hygiene

This term connotes the procedure prescribed for the care of the staff in storage. As already indicated, in spite of careful initial precautions, dampness and insect and rodent fauna creep unnoticed into the store. Constant vigilance is the only answer to this problem.

(i) As far as possible proper ventilaton should be ensured by keeping windows open at least during working hours. As already mentioned. insects thrive well in warm humid air, and dry grains absorb moisture from the humid atmosphere leading to fungal and bacterial infection. Cool, dry air circulating in the godown will reduce this risk to a great extent. On rainy days the outside air may be heavily moisture-laden when there might be a risk in freely admitting it inside. In other seasons good ventilation is essential.

Hermetic or air-tight storage has been experimentally proved to keep grains in sound condition for a long time. This is so if the grain is initially sound and dry and is tightly packed inside. This is difficult to secure under normal conditions of storage. The intergranular air is sufficient to support a insect population. The same observation holds good in regard to bulk storage bins.

(ii) The stock should be critically examined once a fortnight by taking representative samples and graded (see below).

(iii) Sweepings and spillages should be removed and stored elsewhere.

(iv) If signs of heating are detected the stock should be broken up, the affected bags removed, and the rest of the bags aerated and restacked. If in the affected bags, heating is due to excess of moisture (without being mouldy), the stock should be released for consumption. If it is due to insects, the stuff should be fumigated.

(v) The stacks, floor and walls should be lightly dusted with 5% BHC or DDT dust, which should be renewed at least once in six weeks.

(vi) Empty, used gunnies should be kept separately. Before using them again they should be fumigated or at least dried well in the sun.

VIII. Precautions and Treatment against Pests

(*A*) *Insects*:

Preventive measures to reduce insect infestation from these sources are:

(*a*) Dusting 5% DDT or BHC on walls, floor and on the bags.

(*b*) Spraying an extract of Pyrethrum in kerosene oil or any other suitable spray to reduce moth-infestation.

(*c*) Use of insecticidal smokes in godowns.

(*d*) Use of only fumigated or sun-dried and brushed gunny bags which have been previously used.

(*e*) Mixing insecticidal or mineral dusts with grains (for seed grains only).

(*f*) Proper disposal of sweepings and spillages.

In spite of these precautions, and for reasons beyond our control insect infestation may increase beyond permissible limits, *i.e.*, the stock may get into C and D grades when drastic treatment, *viz.*, fumigation has to be resorted to.

(*g*) *Fumigation* is a chemical process wherein the infested grain is enclosed in an atmosphere which is poisonous to animal life. The grains to be treated are put in an air-tight chamber or receptacle (in the case of large stocks, a fumigation tent is employed to cover them) a measured quantity of the chemical (known as fumigant) is let in, and a definite interval of time is allowed for the chemical to act. The fumigant, generally a liquid, volatalises into gas which penetrates into the mass of grain and kills insects (and other animals) in it. Fumigants are therefore highly poisonous, volatile and often inflammable and should only be handled with expert care.

There are several common grain fumigants of which those in common use are mentioned in Table I. The dosages recommended are generally for the volume occupied (in terms of c.ft.) rather than for quantity of grain, since a certain concentration of gas has to be built up irrespective of whether the whole space is occupied or not. Fumigated grain may remain free from serious infestation for the next two to six months, depending on whether it has been effective against insect eggs, and other factors.

TABLE I

Fumigant	Dosage	Minimum interval required	Remarks
Ethylene dichloride *plus* carbon tetrachloride (Killoptera)	20–30 lb. per 1,000 c.ft.	2–3 days	One ton roughly occupies 50 c.ft.
Ethylene dibromide ..	3 lb. per 1,000 c.ft.	6-8 days	
Phostoxin ..	6–15 tablets per ton	4–6 days	

All grains absorb a small percentage of fumigant, particularly those with a high fat content like oilseeds. Other things being equal the smaller the particle size the more the fumigant absorbed, so normally *soji*, flours and other milled products, should not be fumigated. After fumigation, proper aeration is important to prevent pockets of high concentration of gas remaining. Prolonged exposure of seed grains to fumigants is bad in that the germ may be seriously affected.

Finally due to the hazards involved and the techniques required, fumigation should not be attempted by untrained personnel.

Note.—In milling practice, infested grain is often earmarked for milling (for example, *baseen* from bengalgram). Such grain is first put through a blower, which blows away insect bodies, fragments, husk, etc. If the material is heavily infested, the product is likely to have a bitter taste and off-flavour.

(*h*) Other methods which are not commonly employed for freeing grain from insects are:

(*i*) *Superheating.*—A short exposure to 100–120° C. kills all stages of insects in grain.

(ii) *Admixture of mineral dusts.*—Finely ground inert dusts like quart, felspar, clinker, paddy husk, ash, etc., mixed in small proportions with grains act as deterrents on hard-bodied insects. This treatment has little effect on immature stages. Considering the difficulty of separating the dust from the grain its use could be restricted to small parcels of seed grain.

(iii) *Hermetic or air-tight storage.*—It means storage of grains in a receptacle that does not permit exchange of gases with the outside air. At present this condition is difficult to fulfil.

(iv) *Drying*.—Commercial elevators are equipped with drying facilities. In small-scale storage drying in the sun or in the shade can be resorted to as often as necessary. Rice should not be put out in the sun while flours do not lend themselves to drying in thin layers.

(*B*) *Rodents:*

Rodents invade the store through burrows in the floor and walls, climb down from the roof, slide down the storm water drains, gnaw through bottom of wooden doors and slip in through broken window panes. They may also come in hidden in grain bags. They can be controlled by

(*a*) Rat-proofing the store,

(*b*) Systematic cyanogassing of rat-holes,

(*c*) Trapping, and

(*d*) Baiting.

(*a*) *Rat-proofing*.—Simple structural improvements that may be mentioned in this connection are:

A *pucca* floor and walls, wire mesh protection to windows, covering the openings of storm water drains with wire mesh, filling up the gap between top of the walls and the roof, if the latter is of tiles or sheeting, and nailing thin metal sheets on the bottoms of wooden doors.

(*b*) A campaign of *Cyanogassing* rat-holes inside and outside godowns, once a fortnight at least should be made a regular programme.

(*c*) *Trapping*.—There are a number of indigenous types of traps which could be pressed into service.

(*d*) *Baiting*.—There are a number of proprietary rat-poisons (raticides) which are exposed in an acceptable medium (grains, cooked rice, stale bread, cookies, etc.) for the rats to take in. Zinc phosphide is the most popular raticide now. Baiting involves a certain technique which it is not possible to go into in this paper.

IX. Conclusion

From the foregoing account, it is clear that grain preservation demands constant attention and vigilant care. This is because the natural factors that cause deterioration and spoilage work their way insidiously into the body of the grain and work under cover, as it were. The battle against them has to be fought on a planned systematic basis. It is worthwhile too, because in the present campaign for greater production in the agricultural sector, conservation of grain stocks from insect and rodent infestations has a vital role to play.

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EXTENSION AS I HAVE LEARNT

By A. Seshadri Iyer*

Extension could be defined as teaching in the broadest sense of the word. This teaching is not the formal education that is given in the class-room.

The class-room of Extension is the farm, the farm building, the field, the home, etc. This method of teaching will expand the welfare and happiness of farm people.

Extension helps farm people in bringing answers to their problems from experimental laboratories and takes the problems from farm and home to guide the research work of the future.

Extension teaching is not confined to bringing knowledge on improvement of farm and home, but also the development of local leadership and ability to build and use a plan for farm and community enterprises.

This method of teaching is always done through demonstrations and there is not any rigid plan for this teaching. The successful extension worker uses thousand and one ways of his own to impart a practical knowledge of things to the farmers.

Extension is responsible for providing every farm family with the up-to-date information. It has a responsibility to the research staff of Agriculture, Animal Husbandry, Home Science Departments, etc. to get a widespread distribution of experimental results obtained in these various agencies.

Extension's responsibility to the farm family has many aspects. All the information developed by experimental stations, and research institutes must be gathered, placed in a useful form and made available to the farm families. This is combined with the best practices of farmers and home makers gained through many years of experience.

This information is made available in the form of printed publications, at meetings, demonstrating tours, and by other means which may meet best, a particular situation. The information used in this teaching programme concerns every phase of farm and home life.

Making information available is not enough. This important thing is that the information be used by those to whom it is intended to. This means creating a desire for it.

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In addition to use of the specified and factual information, extension teaches the farm family to prepare a plan of operation, assists them in carrying out and encourages this planning at a community level.

Extension does not come to the farm family with a fixed programme and a hard and fast set of rules. Extension encourages the development of self-reliance and individual planning ability on the part of rural people. After these are developed extension brings all available facts on any given problem to farm families, and assists them to find the right answer for their own area and conditions.

It is the village level worker who maintains the direct contact with the farm families. The other technical staff or the specialists should be always alert and quick in supplying the village level worker, the answer for the problems he would face in the field. If further information is needed the technical staff or specialists should refer the problem to the proper research or experimental stations.

Extension should work, always as an education arm of the Departments of Agriculture, Animal Husbandry, Cottage Industries, Home Science, etc. Extension Service is the major outlet for the material developed in the research work of departments related to farm and home. The extension department in turn is also responsible for these departments for explaining and interpreting national programme and policies to farm people.

Extension worker must think clearly and analyse all the information that is relayed to the farmer and general public. This information must be correct and must be adoptable to local conditions. Extension worker must make sure that the information he provides should be best suited for the welfare of farm community as a whole.

All said and done he must achieve a position of trust and confidence in the minds of the public.

As the 4-H Club Programme has assured a very large place in the extension programme in U.S.A., here also in our country, the Young Farmers' Programme should be developed in such a way that National Extension Service, through Young Farmers' Clubs acts as an opening through which all the research information could be conveyed to the public.

Abstracts

ENTOMOLOGY

1. Cromroy, H. L. (1958), "A preliminary survey of the plant mites of Puertorico," *J. Agri. Univ.*, P.R., **42** (2), 39–144.

The author has reported results of his taxonomic study of the phytophagous mites occurring in Puertorico. The families studied are *Tetranychidæ*, *Tenuipalpidæ*, *Tarsonemidæ* and *Eriophyidæ*. Brief notes on general morphology, biology and description of species are given in the paper.

(D. V. M.)

2. Descamps, M. (1956), "Two harmful diptera on rice in North Cameroun, P.O., P. sp. aff. 1," (In french) *Phytiat Phytopharm*, **5** (2): 109–16. [*Abst*: in *Biol. Abstracts*, 1958, **32** (7), 25007].

Pachydiplosis oryzæ Mani is an important pest of rice in North Cameroun in West Africa; it is found parasitised by *Tetrastichus pachydiplosisæ*, *Platygaster pachydiplosisæ* and *Aplastomorpha camerunus*. Control is difficult as the insect infestation is maintained over enormous areas of wild rice during the dry season. Biological control appears to be the only feasible solution.

(D. V. M.)

3. Butani, D. K. (1958), "Effect of Endrin on the incidence of sugarcane leaf hoppers," *Ind. Jour. Sug. Research & Development*, **2** (4), 204–07.

Large-scale trials against *Pyrilla* with Endrin ($C_{12}H_8Cl_6O$), at 0·1 lb. actual Endrin-emulsion per acre diluted in 100 gallons of water has been found to significantly reduce average number of egg-masses, percentage of affected leaves and also the number of eggs per egg-mass. In view of its high toxicity, the author advocates all precautions and care in handling the material.

(D. V. M.)

4. Mohammad Ali, S. (1958), "Common sugarcane mealy bugs in Bihar (*Coccidæ Hemiptera*)," *Ind. Jour. Sug. Research & Development*, **2** (4), 179–84.

Three species of mealy bugs occur on sugarcane in Bihar. They are *Ripersia sacchari* Green, *Saccharicoccus sacchari* Cockerell and

Pseudococcus saccharifolii Green. Brief notes on their morphology, life-cycle and behaviour are given. The author maintains that *S. sccahari* and *P. saccharifolii* appear to be two separate species and not synonyms of a single species as hitherto believed.

(D. V. M.)

5. Channabasavanna, G. P. (1958), " *Smynthurodes betæ Weste.* [= *Trifidaphis phaseoli*: (Pass.)], a new aphid pest of French beans in Mysore, India, " *FAO Plant Prot. Bull.*, **6** (7), 103–06.

Root portions of the infested French bean plants are found clustered with the aphid as a result of which the aerial growth of the plant is stunted. This appears to be a new record for India.

(D. V. M.)

6. Puttarudriah, M. and Channabasavanna, G. P. (1958), " Occurrence of an eriophyid mite as a new pest of garlic (*Allium sativum*) in Mysore, " *FAO Plant Prot. Bull.*, **6** (8), 123–26.

An unidentified eriophyid mite has been noted by the authors to cause stunting of garlic crop in Kolar District of the Mysore State. The most characteristic symptom is that the tips of the leaves are found tucked within the next older leaves, presenting an arched appearance. Brief description of the mite is given.

(D. V. M.)

AGRICULTURAL CHEMISTRY

1. Chaudhury, A. K. (1957), " Improvement of soil structure by growing berseem under different fertiliser treatments, " *Journal of Soil and Water Conservation of India*, **5,** 174–77.

The percentage of water-stable aggregates (1–5 mm.) increased after growing berseem. N + P, and to a lesser extent P alone, increased fodder yields and further increased the percentage of water-stable aggregates. Potassium had no effect on the soil structure.

(K. SHANKAR)

2. Sen, A. and Paul, N. B. (1957), " Solubilisation of phosphate by some common soil bacteria, " *Curr. Sci.*, **26,** 222.

In cultures containing $(NH_4)_2SO_4$ as the source of N, *Bacillus subtilis*, *B. mycoides*, *B. megatherium* and *B. mesentericus* released soluble P from Ca and iron phosphates, calcium glycerophosphate and lecithin. *B. mesentericus* and *B. mycoides* did not release soluble P from bonemeal but utilised the soluble P already present. With urea as the source of

N, *B. subtilis* utilised soluble P in Ca and ferric phosphates, but the other bacteria liberated soluble P therefrom.

(K. SHANKAR)

3. Ramacharlu, P. T. (1957), "Rate of evaporation of water in relation to particle size distribution in soils," *Journal of Indian Society of Soil Science*, **5,** 117–21.

Evaporation-time curves, showing the percentage fraction lost of the total evaporable water in 30 days, indicated the following decreasing order of evaporation rates from different soils. Sand > desert soil > red soil > alluvial soil > forest soil > alkaline soil > laterite > black soil. This sequence coincides with a decreasing order in the percentage fraction of dry soil particles — 0·076 mm., except for black soils which contain Montmorillonite of high hydration capacity. Saline soils show a special behaviour; the very high initial evaporation rate rapidly decreases, possibly due to the interference of the scum formed on the surface from the high amounts of dissolved salts in the soil.

(K. SHANKAR)

4. Chakravarthi, S. (1957), "Extraction of plant nutrients from soil by different acidic substances," *Journal of the Indian Society of Soil Sciences*, **5,** 73–77.

Cellophane bags containing 5 gm. of air-dry soil were suspended in bottles containing 50 c.c. acetate buffer of pH 4·8, 2 g. of H-resin or 10 c.c. of a 2·5% suspension of H clay, to simulate root-soil system. After equilibrium was reached in about 2 weeks, the Ca, Mg and K were determined in the buffer solution or in the absorbing materials. The amounts thus obtained were generally less than those by direct extraction with the acetate buffer. No more nutrients were extractable by the H-system even if the time of contact with the soil was prolonged over 2 weeks, but treatment with a fresh buffer solution released more nutrients. The release of Mg and especially K was slower than that of Ca.

(K. SHANKAR)

5. Anant Rao, N. K., Agarwal, T. P. and Pawar, K. S. (1957), "Phosphate manuring of sannhemp green manure," *Indian Journal of Agronomy*, **1,** 215–19.

Application of 160 lb. per acre P_2O_5 as superphosphate at sowing and turning in the crop after 49–56 days, gave the best wheat yields on a sandy soil.

(K. SHANKAR)

6. Raheja, P. C., Dhilbu, H. C. and Luthra, G. L. (1957), " Fertilisation investigation in maize, " *Indian Journal of Agronomy*, **1,** 221–35.

The yield response was 7·4–8·1 lb. of grain per lb. of N applied within the range 20–60 lb. per acre N and 1·53–3·45 lb. per lb. of P_2O_5 within the range 40–120 lb. P_2O_5 per acre. Drilling was more effective than broadcasting, the most effective depth being $2\frac{1}{2}''$ below the seed line. A residual response to N was observed.

(K. Shankar)

7. Bhaumik, H. D. (1957). " Relative effects of varying doses of N and Phosphoric acid on the yield of ' Gora ' paddy in Kenthol (calcareous) and Hazaribagh (non-calcareous) soils, " *Journal of Soil and Water Conservation of India*, **5,** 140–43.

Kenthol soil of pH 6·8 was richer in clay and CO_2 but poorer in total N, organic carbon and soluble P than Hazaribagh soil of pH 6·0. With no manuring, total yields on Kenthal soils were quarter to those on Hazaribagh soil. 50 lb. per acre N doubled the yields on Hazaribagh soil but had no effect on the other. On Hazaribagh soil 50 lb. per acre of P or N had no effect applied separately, but when applied together yields increased sixfold. On both soils high rates of P had little effect on yield. It is thought that P and N fertilizers with acidic after-effects will gradually ameliorate kenthol soils.

(B. V. Venkata Rao)

8. Anant Rao, N. K., Gupta, M. L. and Dandanate, M. D. (1957). " Response of three varieties of wheat to three sources of nitrogen in three different doses and their irrigation with three levels of irrigation, " *Indian Journal of Agronomy*, **1,** 255–62.

A light loam (pH 7·6) low in N, irrigated wth 60,000, 90,000 or 120,000 gallons per acre and receiving N as castor cake, $(NH_4)_2SO_4$ or farm compost at 30, 60 or 90 lb. N per acre, gave the best yields with medium irrigation castor cake supplying 30 lb. N. per acre. $(NH_4)_2SO_4$ was more effective than farm compost. One variety showed better responses to castor cake and $(NH_4)_2SO_4$ than did two others. Responses to higher N rates were also better. $(NH_4)_2SO_4$ at 90 lb. per acre N reduced yields.

(K. Shankar)

9. Hogg, D. E. (1957), " The assessment of available potassium in soils, " *Potash Review Subject*, **5,** 11th suite.

In New Zealand, if exchangeable K is above 0·6 m.e. per cent., responses to potash are very unlikely. In the north island, K responses

are improbable where exchangeable K is above 0·6 m.e. per cent. and probable below 0·5 m.e. per cent. Ammonium acetate extraction of soils would be a better extracting medium than Morgan's reagent.

On certain south island soil types exchangeable K is a poor guide to the K-supplying power of the soil. The use of a nitric extractant after a preliminary separation of soils by a rapid ammonium acetate extraction, shows promise.

A study of exchangeable — K values in relation to rainfall suggests that the employment of exchangeable K as an index of potassium supplying powers will be useful in areas where rainfall exceeds 45 inches a year.

(K. SHANKAR)

Research in Progress

In the Fodder Research Scheme at Kudige in Coorg District, amongst the fodder grasses, *Dicanthium annulatum* and *D. caricosum* showed very good growth during the quarter. Similarly, the growth of *Phalaris*, *Rescue grass* and Newzealand *Perennial Rye* Grass continued to be good during the quarter under report (ending September 1958). In the manurial trial on para grass (*Brachiara mutica*), the seventh cutting was taken and the treatment receiving 20 lb. N + 20 lb. P_2O_5 as Ammonium sulphate and superphosphate respectively recorded highest yield. In trials with fertilisation of Lucerne (*Medicago sativa*), application of 40 lb. P_2O_5 as superphosphate appeared to enhance the yields.

At the Agricultural Research Station, Nipani, in Belgaum District, it has been observed that retaining 10–12 leaves per plant at the time of nipping is better as the leaves develop desirable expansion and thickness. In the top-dressing trials with *Bidi* Tobacco, application of superphosphate has not shown any significant response and studies are under way to ascertain whether application of superphosphate to the preceding green manure crop (sunn-hemp) would in any way be helpful. To economise the labour and time involved in 'suckering' operation, it has been observed that application of vegetable oils to leaf axils at the time of nipping could effectively inhibit the growth of apical suckers and amongst the oils tested, coconut oil appears to be the best. It may be mentioned herein that in trials carried out in North Queensland, it has been found that the control of sucker growth obtained with oils is equivalent to the control obtained by repeated hand suckering and no adverse effects on the quality of the cured leaves have been observed due to the use of the oils. Application of "Folidol E. 605" at the rate of $\frac{1}{6}$ oz. in 3 gallons of water is found to give effective control of Tobacco aphids while application of "Aldrex" 5% powder round about tobacco plants is found to minimise the attack by cut-worms during the seedling stage.

At the Government Main Farm, Raichur, in varietal trials conducted with Tur (*Cajanus cajan*) since 1954–55, strain No. 232 has consistently recorded higher yields than the 'local' and appears very promising. In the *rabi* cotton varietal trials, strain No. 5117 appears to be better than '*Hagari*' and 'Local'. Amongst the *rabi* jowar varieties tested, namely, M–35–1, H1, PJ4R, M–47–3, J. 720–2–6–2 and J. 763, M–35–1 was found superior in yield, closely followed by PJ4R.

At the Agricultural Research Station, Gangawathi in Raichur District, it has been preliminarily observed that the optimum time for

sowing LAXMI cotton is from middle of August to the end of the first week of September. Similarly, yields of *Rabi* Jowar appear to be more when sowings are done in the month of September itself. Amongst the varieties of *Rabi* Jowar tested, five improved varieties obtained from Bijapur, *viz.*, *Gund*, *Dhagadi*, *Olphad*, *Ron* and *Pound* were found on par in yields with that of M-35-1 and PJ4R and are being tested again.

In the Division of Agricultural Chemistry at Bangalore a new experiment was started to investigate the possibilities of reducing the continuous irrigation given to paddy to intermittent and lower amounts in order that the existing irrigation resources could be used over large areas. Field trials were also laid out to evaluate the performance of new nitrogenous fertilisers such as calcium, ammonium nitrate, chilean nitrate, etc., which are being imported in increasing qualities in recent years. During the quarter under report, critical studies were also initiated to ascertain the role of bulky organic manures—whether they serve any other function than merely supplying plant nutrients.

As reported in the last quarter, a number of Agronomical experiments were completed at the Agronomy Section, College of Agriculture, Dharwar. In a fertiliser trials on Chillies (*Capsicum frutescens*) it has been observed that a combined application of 40 lb. of N and 10 lb. P_2O_5, would help in increasing the yields to the extent of 43·0%. An exploratory trial was carried out to study the effects of foliar spray on paddy with urea, superphosphate and potassium sulphate in addition to soil application of fertilisers. While the individual results were not significant, there appeared to be 20% increase in yield by foliar spraying over check plots.

In pot culture studies on *Karl* (alkaline) soils—usually found in paddy lands—various soil amendments were taken up for trial. Yield data obtained reveal that application of 20 cartloads of farmyard manure along with half of a ton of sulphur and 60 lb. of P_2O_5 per acre is very beneficial.

In the Division of Entomology at Bangalore and its Sub-Sections, a number of interesting investigations have been completed and reported. In field tests with the paddy stem-borer (*Schœnobius incertulas* Wlk.), it has been revealed that insecticidal treatments are not effective against grown-up larvæ in the stem and that proper timing of application is most important for effective and economical control of this major insect pest. Spraying with mineral oil saturated with Dieldrin (Technical) 4%, is found very effective against the gally-fly *Pachydiplosis oryzæ* at Kumta in North Kanara District, where its control is a serious problem. The peak period of emergence of adult gall-fly

at Kumta is found to be in the 3rd week of September and that on an average this pest takes about 24 days to complete one generation.

Investigations carried out at the Agricultural Research Stations, Hagari and Siruguppa, show that Jowar varieties differ in their responses to the attack of *Atherigona indica*, the shoot fly, Co. 9 being highly susceptible whereas M–31–2 is least affected. Slight reduction in the incidence of the pest is obtained when the young crop is dusted with 10% DDT or BHC.

Work on Sugarcane pests was continued both at Mandya and Hebbal. A new Eriophyiid mite has been observed causing blisters on the leaf sheaths and this malady is found widespread all over the Sugarcane areas in the State. Amongst leaf hoppers, a number of new species have been noted for the first time—*Kolla* sp., *campbellinella illustrata* Dist., *Deltocephalus* sp., *Perkinsiella insignis* Dist., *Tropidocephala* sp., *Perigrinus maidis* Aslim., and *Delphax* sp.

Two new records of insects on Cotton have been reported. They are the guava scab bug—*Helopeltis antonii* Signoret and the ricanid bug *Ricania fenestrata* Fabr. Both adults and nymphs of *H. antonii* cause damage to young cotton bolls, tender leaves and shoots. The affected bolls develop a sort of a scab, become deformed and finally dry up.

Insecticidal tests against Cotton pests have revealed that the cotton Jassids and aphids *Empoasca* sp. and *Aphis gossypii* are effectively controlled with spraying Folidol E. 605, Basudin and Endrin. The effects of the Chemicals are, however, lost in the third week after application.

—(D. V. M.)

Notes and News

FARMERS' FORUM AND YOUNG FARMERS' ASSOCIATION

' Aloka '

A happy event with which the Mysore Young Farmers' Association associated itself was the starting of the ' Aloka ' Centre at Yelwal, Mysore. The training course which began on 3rd November 1958 was conducted for six weeks under the leadership of Dr. and Mrs. Lynton. Senior extension personnel and representatives of farmers with an interest in Young Farmers' Movement were among the trainees; and out of twenty, eight were from Mysore State.

A discussion on the leaders' training camps which were due to be organised in Mysore by the Young Farmers' Association was taken up by the representatives at the ' Aloka ' and the question is receiving attention.

Visitors

Two American International Farm Youth Exchange Delegates, Mr. Jeslie Giles and Miss Shellin Wollington visited Mysore in the month of October and while here called at the Office of the Farmers' Forum and Young Farmers' Association and had discussions relating to Farm youth activities with the international exchangees of this State.

Bangalore North Taluk Branch

The Bangalore North Taluk Branch has made some progress along work among farmers and the lead has been along the lines of an emphasis on Project work. A Hobli Council is now formed at Hessaraghatta and marks a step forward in the Young Farmers' Organisation.

Young Farmers' Rally

Arrangements are going on briskly for the Young Farmers' Rally to be held on the Fourth, Fifth and Sixth of February 1959 and our members are looking forward to it as a major event.

Bangalore District Seminar

The Bangalore District Forum conducted a Seminar and Exhibition at Bangalore, during the month of November 1958, which was well attended by representatives from all Taluks. Discussions took place on local problems. A *Souvenir* marking the occasion was issued.

International Agricultural Economists Conference

The Farmers' Forum, India, and the Young Farmers' Association, India, together sent two of our members as delegates to the International Agricultural Economists' Conference held in Mysore and we appreciate the opportunity.

Training Camp at Bangalore

Dr. Lynton, Director, 'Aloka' Centre, also conducted his first lesson at a training camp programme at Bangalore. And this camp was continued at Dasarahally, Bangalore North Taluk. The Bangalore North Taluk thus gave a start to the kind of camps envisaged by the Young Farmers' Association, but later in the same enthusiasm conducted a Rally of the local clubs also.

Our Vice-Presidents

Two of our Vice-Presidents, Sri. T. Karle and Sri. V. Masiappa joined the group of farm leaders sent on a tour to U.S.A. after the Second Farmers' Forum Seminar. We are awaiting their return.

—*Secretary.*

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